MYCOTAXON
ISSN (print) 0093-4666 (online) 2154-8889 Mycotaxon, Ltd. ©2019
July–September 2019—Volume 134, pp. 481–488
https://doi.org/10.5248/134.481

Novel cyphelloid fungi in *Glabrocyphella*, *Heteroscypha*, and *Rectipilus* from Brazil

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Abstract—New records of cyphelloid fungi from Brazil are presented, based on specimens collected and identified by J. Rick and conserved at Herbarium PACA (São Leopoldo, Rio Grande do Sul). *Glabrocyphella cyathiformis* sp. nov. is characterized by small (0.1–0.5 mm diam.), pale yellow, turbinate basidiomes and ellipsoid to fusoid basidiospores (5–6 × 2–2.5 μm). *Flagelloscypha malmei* is recombined as *Heteroscypha malmei* comb. nov., and *Rectipilus natalensis* is reported for the first time from the Americas. Descriptions, photographs, and illustrations are presented for the three species.

Key words—*Agaricomycetes, Auriculariales, Marasmiaceae,* mycobiota, taxonomy

Introduction

The cyphelloid fungi are an artificial assemblage characterized by basidiomes morphologically similar to the original concept of the genus *Cyphella* Fr. The type species [currently accepted as *Aleurodiscus digitalis* (Alb. & Schwein.) Donk] was originally described as a *Peziza*; indeed, cyphelloid fungi can be characterized as discomycetes with basidia, according to Donk (1966). One difference that can be noted in the field is that discomycetes have their hymenium directed upward, while those of cyphelloid fungi are directed downward, due to differences in the release of spores from asci and basidia.

Cyphelloid fungi have cupulate, discoid, tubular to flattened basidiomes and a smooth to more or less wrinkled hymenophore. Basidiomes are usually less than 1 mm long and grow on litter (grass, leaves, twigs, and other small substrates) and rotten wood. They are externally covered with specialized hyphae, which serve as important characters for circumscribing genera (Donk 1959, Cooke 1961, Agerer 1983, Bodensteiner & al. 2004). According to Agerer (1986), the outer hyphae form the most striking features of cyphelloid basidiomes.

Initially, these fungi were grouped in three genera—*Cyphella*, *Solenia*, and *Porotheleum* (Cooke 1961)—but currently more than 40 diverse genera are recognized for the group (Bodensteiner 2007). Several new cyphelloid species have been based on Brazilian collections (Spegazzini 1889; Hennings 1897, 1908; Rick 1906, 1931, 1959, 1960; Cooke 1961; Singer 1989; Gorjón & Jesus 2014) and a few reports have been published in the past decades (Putzke 2002; Meijer 2006; Sulzbacher & al. 2008, 2009).

During a taxonomical review of cyphelloid type specimens described by J. Rick from Southern Brazil (Trierveiler-Pereira & al. unpubl. data), additional collections of cyphelloid fungi kept at Herbarium PACA (São Leopoldo, Rio Grande do Sul, Brazil) were also examined. Here we present novelties resulting from this research on cyphelloid fungi.

Materials & methods

Dried basidiomes were measured, photographed, and morphologically analyzed. Colors of macrostructures were coded according to Kornerup & Wanscher (1978). For microscopical analyses, basidiomes were hand-sectioned with the aid of a razor blade under a stereoscopic microscope (Agerer 2002). Sections were mounted in distilled water and 3% KOH or 3% KOH with 1% aqueous phloxine to observe and measure the microstructures. The coloring of pigmented elements (e.g., external hyphae and spores) was evaluated in distilled water (Bodensteiner 2007). Amyloid and dextrinoid reactions were tested with Melzer's iodine reagent. Dimensions recorded correspond to the hyphal diameter without crystal covering, spore length without apiculus and basidia without sterigmata.

Taxonomy

Glabrocyphella cyathiformis Trierv.-Per. & Thorn, **sp. nov.** FIG. 1

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Differs from *Glabrocyphella palmarum* by its smaller, turbinate basidiomes and its smaller, subfusiform basidiospores; and from *G. rubescens* by its grayish yellow basidiomes and its narrower, subfusiform basidiospores.

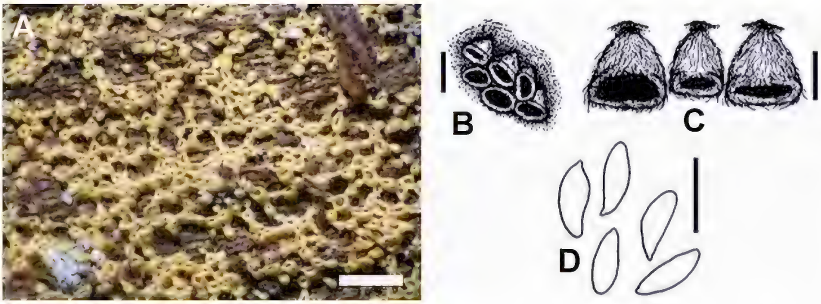

Fig 1. *Glabrocyphella cyathiformis* (PACA 20938, holotype). A. Basidiomes on rotten wood; B, C. Basidiomes in detail; D. Basidiospores. Scale bars: A = 1 mm; B = 0.5 mm; C = 0.3 mm; D = 5 µm.

Type: Brazil, Rio Grande do Sul, Salvador do Sul, 19.IX.1944, J. Rick (**Holotype**, PACA 20938, as *Solenia* sp.)

Etymology: Latin, *cyathiformis*: cup-shaped—slightly wider at the top than at the bottom, referring to the shape of the basidiomes.

Basidiomes clustered in small groups that are in contact, forming a reticulate pattern (rarely scattered), short-cylindrical (when young) to turbinate, 0.1–0.5 mm diam. × 0.3–0.5 mm high; cup margins curving inwards; externally grayish yellow (3B4) to light yellowish (4A4), velvety; hymenium smooth, pastel yellow (1A4). Subiculum absent. Growing on a small piece of rotten wood.

External hyphae adpressed to the surface, some projecting ca 40–100 µm from the basidiome, pale yellow, thick-walled, tortuous, 1–4 µm diam., fibulate, non-dextrinoid and non-amyloid, lacking encrustations or distinctive features, apices round. Subhymenial layer 10–25 µm thick; hyphae agglutinated, hyaline, ca 2 µm diam., fibulate. Hymenial layer 10–15 µm; basidia not seen; basidioles tightly packed together, clavate to short-clavate, hyaline, 9–15 × 4–5 µm, with clamp connections at the base; sterile elements not seen. Basidiospores subfusiform, hyaline, smooth, thin-walled, (4.8–)5–6 × 2–2.5 µm, with a distinct apiculus, non-dextrinoid, non-amyloid.

Ecology & distribution: growing on rotten wood; known only from the type locality.

Additional specimens examined:

Glabrocyphella rubescens: **BRAZIL, Rio Grande do Sul**: São Leopoldo, 1932, J. Rick (PACA 15276, isotype, labeled '*Solenia rubescens* Rick').

Glabrocyphella palmarum: **BRAZIL, Rio Grande do Sul**: São Leopoldo, 1931, J. Rick (PACA 12863, as *Cyphella palmarum*).

REMARKS—*Glabrocyphella* W.B. Cooke included 12 species when introduced by Cooke (1961), and a 13th species, *G. stercoraria* Barrasa & al., has since been proposed.

Glabrocyphella cyathiformis is characterized by turbinate, yellowish basidiomes velvety on the exterior with external hyphae lacking encrustations or any other distinctive feature and without a subiculum and ellipsoid to fusoid hyaline basidiospores [(4.8–)5–6 × 2–2.5 µm].

Glabrocyphella cyathiformis is morphologically close to *G. palmarum* (Berk. & M.A. Curtis) W.B. Cooke, which differs by its ovate to tear-shaped, larger (6–7 × 3–4 µm) basidiospores (Cooke 1961) and larger (≤2 mm high) basidiomes (Burt 1914, as *Cyphella palmarum*). From our examination, Rick's PACA 12863 collection of *G. palmarum* has basidiospores (7.5–)8–9 × 2–3 µm and cupulate-stipitate basidiomes.

Glabrocyphella rubescens Rick ex W.B. Cooke was described based on specimens collected in Southern Brazil. This species is distinguished from *G. cyathiformis* by its cream-colored basidiomes that turn flesh-color upon bruising and its ovoid basidiospores (4.5 × 3.5 µm, Cooke 1961; 5–6 × 3–4 µm, from our examination of the isotype).

Heteroscypha malmei (W.B. Cooke) Trierv.-Per., Baltazar & Thorn, **comb. nov.**

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≡ *Flagelloscypha malmei* W.B. Cooke, Beih. Sydowia 4: 62, 1961.

BASIDIOMES scattered or mainly in clusters of 2–30 basidiomes, 0.2–0.9 mm diam., cupuliform, external surface yellowish white to pale yellow (1A3, 1A2), tomentose; cup margins hairy, curving inwards; external hairs ca 0.1 mm long; hymenial surface pastel yellow (1A4), smooth. Subiculum absent. Growing on dead palm tree (peduncular bract).

EXTERNAL HYPHAE (hairs) 100–140 × 2–4 µm, hyaline to pale yellow, more pigmented towards the base, thick-walled with narrow lumen, non-dextrinoid and non-amyloid, encrusted with acicular ≤4 µm long crystals; apical end flagelliform, smooth, 20–40 µm long. SUBHYMENIAL LAYER ca 15 µm thick; hyphae agglutinated, hyaline, ca 2 µm diam. HYMENIAL LAYER ca 25 µm; basidia short clavate, hyaline, 15–22 × 4–6 µm, with clamp connection at the base, 4-sterigmate, longitudinally septate at the apex; sterile elements (leptocystidia) observed in the hymenial layer, especially near the margins, tortuous, hyaline, smooth, ca 40 × 4 µm. BASIDIOSPORES fusoid to asymmetrical-ellipsoid, hyaline, smooth, thin-walled, (7.5–)8–10 × (3.5–)4.0–4.5 µm, Q = 2.2 (n = 13), with a distinct apiculus, some germinating with hyphae, non-dextrinoid, non-amyloid; some adhering in groups of 3–4.

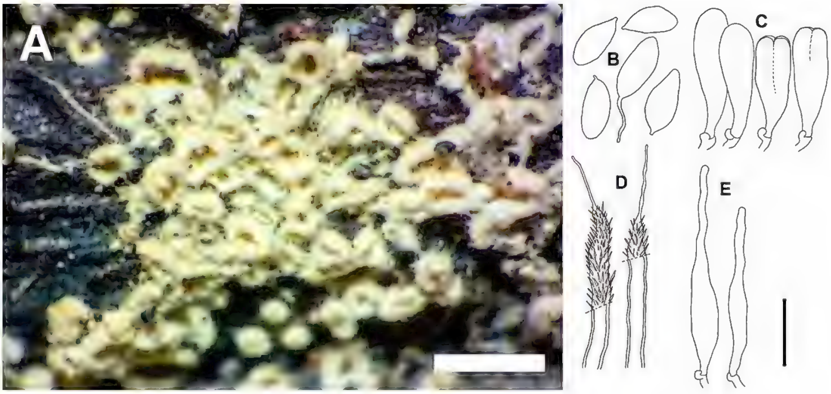

Fig 2. *Heteroscypha malmei* (PACA 12865). A. Basidiomes on rotten wood; B. Basidiospores; C. Basidioles and basidia; D. External hyphae; E. Hymenial sterile elements. Scale bars: A = 1 mm; B–E = 10 µm.

Specimen examined: **BRAZIL. Rio Grande do Sul**: Salvador do Sul, 1943, J. Rick (PACA 12865, as *Cyphella palmarum*).

Ecology & distribution: growing on rotten wood; known only from Southern Brazil, State of Rio Grande do Sul, from the municipalities of Santo Angelo (holotype of *Flagelloscypha malmei*; Cooke 1961) and São Salvador (this study).

Remarks—In the examined material, the hymenial layer of most of the basidiomes has been eaten by insects and only the external layer and hairs remain, therefore, few basidia and basidiospores were observed.

Heteroscypha Oberw. & Agerer was proposed as a monotypic genus, typified by *Cyphella applanata* [≡*H. applanata* (P.H.B. Talbot) Oberw. & Agerer]; detailed illustrations and description of the type specimen were presented, showing the apically septate basidia (Agerer & Oberwinkler 1979). *Heteroscypha malmei* was previously considered a member of *Flagelloscypha* Donk, since the external hairs have acicular crystal encrustations, with the exception of the flagelliform apical end (Cooke 1961).

Our Brazilian specimen of *H. malmei* has slightly longer basidiospores with a Q ratio higher compared with those previously described for *F. malmei* (8–9 × 4–5 µm, Cooke 1961; 7.5–8.5 × 4–5 µm, Q = 1.7, Agerer & Oberwinkler 1979). *Heteroscypha applanata* differs from *H. malmei* by its white, discoid-petaliform basidiomes, its thin-walled external hairs, its fully septate basidia, and its longer basidiospores (9–12.6 × 3.2–5.4 µm, Cooke 1961; 8–10 × 4–5 µm, Q = 2.1, Agerer & Oberwinkler 1979).

Rick's PACA 12865 collection of *Heteroscypha malmei* was labelled *Cyphella palmarum*; however *Glabrocyphella palmarum* differs from *H. malmei* by its holobasidia, its larger (≤3 mm diam.) hairless cups, and its smaller basidiospores (Cooke 1961).

As indicated by Agerer & Oberwinkler (1979), additional fresh materials of these species suitable for cultural, ultrastructural, and molecular studies are highly desirable.

Rectipilus natalensis (W.B. Cooke) Agerer, Persoonia 7(3): 425, 1973. FIG. 3

BASIDIOMES agglutinated, tubuliform, long, 0.5–1.0 mm high; 0.1–0.3 mm diam.; externally light orange (5A5) to grayish yellow (4B4) covered by scattered whitish hyphae, pale yellow near the margins (2A3); margins hairy; hymenium light orange (5A4, 5A5), smooth. Subiculum absent. Growing on small pieces of wood.

EXTERNAL HYPHAE compact, closely adpressed to the surface of the basidiome, pale yellow, thick-walled, not encrusted, 2–3 µm diam., clamp connections present, hyphal tips coiled and twisted near the margins, non-dextrinoid and non-amyloid. SUBHYMENIAL LAYER 10–20 µm thick; hyphae agglutinated, pale yellow, ca 2 µm diam. HYMENIAL LAYER 15–20 µm; basidioles yellowish, basidia clavate, 10 × 4 µm, 4-sterigmata, with clamp connection at the base; sterile elements not seen. BASIDIOSPORES globose to subglobose, hyaline, smooth, 3–4(–4.5) × 2.2–3 µm, non-dextrinoid, non-amyloid.

SPECIMEN EXAMINED: **BRAZIL. RIO GRANDE DO SUL**: Salvador do Sul, 9.IX.1944, J. Rick (PACA 22683, as *Solenia* sp.).

ECOLOGY & DISTRIBUTION: growing on rotten wood; known from Southern Africa (Talbot 1956, as *Solenia natalensis*) and Southern Brazil (this study).

REMARKS–*Rectipilus* Agerer contains eleven species (Lucas & Dentinger 2015). Gorjón & Jesus (2014) provided an identification key to nine of these species.

Rectipilus natalensis is characterized by cylindrical, tubuliform basidiomes with external hairs from the upper portions with spirally coiled apices, the lack of subiculum, and small, globose to subglobose, hyaline basidiospores. The original basionym description (Talbot 1956, as *Solenia natalensis*) indicates basidiomes up to 2 mm long, but the Brazilian basidiomes are shorter (up to 1 mm long). Agerer (1973) described the holotype as yellowish, while the Brazilian material has pale orange external surface and is yellowish only near the upper part of the basidiome.

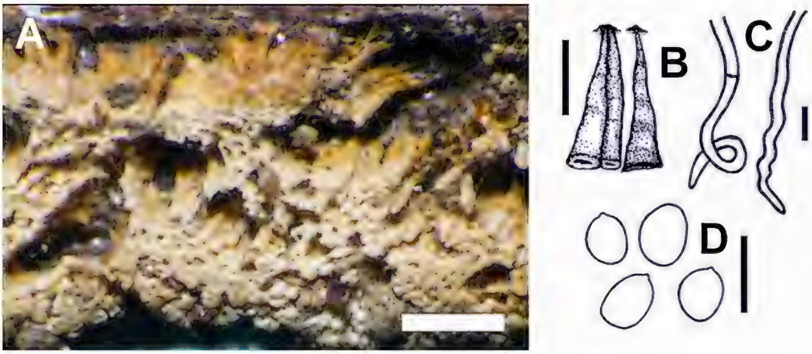

Fig 3. *Rectipilus natalensis* (PACA 22683). A. Basidiomes on rotten wood; B. Basidiomes in detail; C. External hyphal tips; D. Basidiospores. Scale bars: A = 1 mm; B = 0.5 mm; C = 5 µm; D = 10 µm.

Agerer (1973) stated that *R. confertus* (Burt) Agerer and *R. fasciculatus* (Pers.) Agerer are similar to *R. natalensis*, but they lack external hyphae with twisted or coiled apices, and they present different basidiospore morphologies. The only *Rectipilus* species previously reported from Brazil, *R. stromatoides* Gorjón, differs from *R. natalensis* by its basidiomata, which are arranged in a dense, broadly effused, vivid pink stroma (Gorjón & Jesus 2014).

Acknowledgments

The authors are grateful to Dra. Maria Salete Marchioretto (curator of PACA) for sending specimens. We sincerely appreciate all valuable comments and suggestions made by the peer-reviewers: Marcelo A. Sulzbacher (Universidade Federal de Santa Maria, Brazil), Sergio P. Gorjón (University of Salamanca, Spain), and Mario Rajchenberg (Centro Forestal CIEFAP, Chubut, Argentina). This study is a partial result from the post-doctoral research of the first author, with a scholarship provided by the Brazilian government (CNPq/PDJ, proceeding #150233/2017-5).

Literature cited

Agerer R. 1973. *Rectipilus*. Eine neue Gattung cyphelloider Pilze. Persoonia 7(3): 389–436.

Agerer R. 1983. Typusstudien an cyphelloiden Pilzen IV. *Lachnella* Fr. s.l. Mitteilungen der Botanischen Staatssammlung München 19: 163–334.

Agerer R. 1986. “*Cyphellaceae*” versus *Tricholomataceae*, or what is a family? 9–27, in: La Famiglia *Tricholomataceae*, Atti del Convegno Internazionale del 10-15 settembre 1984. Centro Studi per la Flora Mediterranea, Borgo Val di Taro, Italy.

Agerer R. 2002. *Flagelloscypha crassipilata* sp. nov., a species from Peru with extremely thick surface hyphae and big basidia. Mycological Progress 1(2): 225–228. https://doi.org/10.1007/s11557-006-0020-0

Agerer R, Oberwinkler F. 1979. Cyphelloide Tremellaceen. Beihefte zur Sydowia 8: 26–32.

Bodensteiner P. 2007. *Maireina afibulata* and *M. attenuatipilis*, new members of the cyphelloid genus *Maireina* (*Basidiomycota*, *Agaricomycetes*). Mycological Progress 6: 221–228. https://doi.org/10.1007/s11557-007-0538-9

Bodensteiner P, Binder M, Moncalvo JM, Agerer R, Hibbett DS. 2004. Phylogenetic relationships of cyphelloid homobasidiomycetes. Molecular Phylogenetics and Evolution 33: 501–515. https://doi.org/10.1016/j.ympev.2004.06.007

Burt EA. 1914. The *Thelephoraceae* of North America III. *Craterellus borealis* and *Cyphella*. Annals of the Missouri Botanical Garden 1(4): 357–382. https://doi.org/10.2307/2990137

Cooke WB. 1961. The cyphellaceous fungi: a study in the *Porotheleaceae*. Beihefte zur Sydowia 4. 144 p.

Donk MA. 1959. Notes on "*Cyphellaceae*" I. Persoonia 1: 25–110.

Donk MA. 1966. A reassessment of the *Cyphellaceae*. Acta Botanica Neerlandica 15: 95–101. https://doi.org/10.1111/j.1438-8677.1966.tb00217.x

Gorjón SP, Jesus MA. 2014. *Rectipilus stromatoides* sp. nov. (*Agaricales*, *Basidiomycota*), a new cyphelloid fungus from the Brazilian Amazon. Mycosphere 5(2): 393–396. https://doi.org/10.5943/mycosphere/5/2/12

Hennings P. 1897. Beiträge zur Pilzflora Südamerikas II. Hedwigia 36(4): 190–246.

Hennings P. 1908. Fungi Paraënses III. Hedwigia 48: 101–117.

Kornerup A, Wanscher JH. 1978. Methuen handbook of colours. 3rd ed. Eyre Methuen, London.

Lucas A, Dentinger BTM. 2015. *Rectipilus afibulatus* - a new cyphelloid mushroom (*Agaricales*) from Great Britain. Kew Bulletin 70(58): [6 p.]. https://doi.org/10.1007/S12225-015-9598-1

Meijer AAR. 2006. Preliminary list of the macromycetes from the Brazilian State of Paraná. Boletim do Museu Botânico Municipal, Curitiba 68: 1–55.

Putzke J. 2002. *Agaricales* (Fungos – *Basidiomycota*) pleurotóides no Rio Grande do Sul. I – *Anthracophyllum*, *Aphyllotus*, *Campanella*, *Chaetocalathus* e *Cheimonophyllum*. Caderno de Pesquisa, Série Biologia 14: 45–66.

Rick J. 1906. Pilze aus Rio Grande do Sul (Brazilien). Brotéria, Série Botânica 5: 4–53.

Rick J. 1931. Thelephoraceas Riograndenses. Egatea 16: 39–44; 116–124; 199–206.

Rick J. 1959. *Basidiomycetes* Eubasidii in Rio Grande do Sul – Brasilia. 2. *Thelephoraceae*. Iheringia, Botânica 4: 61–124.

Rick J. 1960. *Basidiomycetes* Eubasidii in Rio Grande do Sul – Brasilia. 4. *Meruliaceae*, *Polyporaceae*, *Boletaceae*. Iheringia, Botânica 7: 193–295.

Singer R. 1989. New taxa and new combinations of *Agaricales* (Diagnoses fungorum novorum Agaricalium IV). Fieldiana Botany 21. 133 p. https://doi.org/10.5962/bhl.title.2537

Spegazzini C.L. 1889. Fungi Puiggariani. Pugillus 1. Boletín de la Academia Nacional de Ciencias en Córdoba 11(4): 381–622.

Sulzbacher MA, Desjardin DE, Putzke, J. 2008. *Calathella columbiana* (*Basidiomycota*): new record of a cyphelloid fungus from Brazil. Mycotaxon 105: 37–42.

Sulzbacher MA, Coelho G, Cortez VG. 2009. Studies on cyphelloid fungi in Southern Brazil. The genus *Phaeosolenia* Speg. Boletín de la Sociedad Micológica de Madrid 33: 91–96.

Talbot PHB. 1956. The cyphelloid fungi from South Africa. Bothalia 6: 465–487.